

STS 117 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-117) and International Space Station (13A)

The toxicological assessments of 2 grab sample canisters (GSCs) and one pair of formaldehyde badges from the Shuttle are reported in Table 1. Analytical methods have not changed from earlier reports. The recoveries of the 3 surrogates (^{13}C -acetone, fluorobenzene, and chlorobenzene) from the 2 GSCs averaged 109, 95, and 97 %, respectively. Three formaldehyde controls averaged 93% recovery. The Shuttle atmosphere was acceptable for human respiration.

Table 1. Analytical Summary of Shuttle Samples

Sample Location	Date of Sample	NMVOCs ¹ (mg/m ³)	T Value ² (units)	Alcohols (mg/m ³)	Formaldehyde (µg/m ³)
Middeck (preflight)	6/08/07	0.2	0.01	0.2	--
Flight deck	6/18/07	--	--	--	47
Middeck (end mission)	6/22/07	4.2	0.66	1.0	--

¹ Non-methane volatile organic hydrocarbons.

² Calculated excluding CO₂, formaldehyde, and siloxanes.

The toxicological assessment of 14 GSCs and 8 pairs of formaldehyde badges from the ISS is shown in Table 2. The recoveries of the 3 standards (as listed above) from the GSCs averaged 108, 104 and 98%, respectively. Three formaldehyde control badges [STS-118 return] averaged 85% recovery.

Table 2. Analytical Summary of ISS Results

Module/Sample	Approx. Date	NMVOCs ^a (mg/m ³)	T Value ^b (units)	Alcohols (mg/m ³)	Formaldehyde (µg/m ³)
SM	1/17/07	9	1.48	6	26
FGB	1/17/07	6	0.58	4	--
Lab	1/17/07	6	0.54	5	35
SM	2/15/07	4	0.55	3	29
FGB	2/15/07	5	0.57	3	--
Lab	2/15/07	4	0.13	3	41
SM	3/15/07	8	0.13	6	--
FGB	3/15/07	7	0.57	6	--
Lab	3/15/07	8	0.16	6	--
SM	4/17/07	6	0.15	5	21 ^{c,d}
FGB	4/17/07	7	0.15	6	--
Lab	4/17/07	7	0.48	5	35 ^{c,d}
SM	5/14/07	6	0.13	4	21 ^d
Lab	5/14/07	5	0.10	4	32 ^d
<i>Guideline</i>		<25	<1.0	<5	<120

^a Non-methane volatile organic hydrocarbons.

^b Calculated excluding CO₂, formaldehyde, and siloxanes.

^c Sampled from 4/25 to 4/27

^d Samplers returned aboard STS-118

The ISS atmosphere was found to be acceptable for human respiration. The high T-value of 1.48 on 1/17/07 was due to elevation in C2-C7 aliphatic aldehydes and a small amount

of propenal, which contributed 0.87 units to the total T-value. Since these increases were not identified in the concomitant samples of Lab and FGB air, one must assume a local source in the SM; however, there is no toxicological concern since the T-Values were not elevated in the other modules. The alcohols were near or below the threshold established for protection of the water recovery system. Formaldehyde badges continue to show that the SM has a slightly lower concentration of formaldehyde than the Lab, but both modules are well below the guideline level.

Enclosures

Table 1A: [Analytical concentrations of compounds found in the STS-117 GSCs](#)

Table 1B: [Analytical concentrations of compounds found in 13A GSCs](#)

Table 2A: [T-values of the compounds in table 1A](#)

Table 2B: [T-values of the compounds in table 1B](#)

TABLE 1A
ANALYTICAL RESULTS OF
STS-117 GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m ³)		
	AA04268 Middeck SN 1088 06/22/07 @ 12:50 GMT	AA04266 Preflight SN 1054 06/08/07 @ 13:58 EDT	
TARGET COMPOUNDS (TO-14/POLAR)***			
FREON12	TRACE	<0.025	
CHLOROMETHANE	0.029	<0.025	
FREON114	<0.025	<0.025	
METHANOL	0.11	TRACE	
ACETALDEHYDE	0.47	0.030	
VINYLCHLORIDE	<0.025	<0.025	
BROMOMETHANE	<0.025	<0.025	
ETHANOL	0.49	TRACE	
CHLOROETHANE	<0.025	<0.025	
ACETONITRILE	TRACE	TRACE	
PROPENAL	TRACE	<0.025	
ACETONE	0.30	0.040	
PROPANAL	0.16	TRACE	
ISOPROPANOL	0.039	0.10	
FREON11	<0.025	<0.025	
FURAN	<0.025	<0.025	
ACRYLONITRILE	<0.025	<0.025	
PENTANE	TRACE	<0.025	
2-METHYL-2-PROPANOL	TRACE	<0.025	
METHYLACETATE	<0.025	<0.025	
1,1-DICHLOROETHENE	<0.025	<0.025	
DICHLOROMETHANE	TRACE	<0.025	
3-CHLOROPROPENE	<0.025	<0.025	
FREON113	<0.025	<0.025	
N-PROPANOL	TRACE	<0.025	
1,1-DICHLOROETHANE	<0.025	<0.025	
BUTANAL	0.11	TRACE	
2-BUTANONE	0.076	TRACE	
CIS-1,2-DICHLOROETHENE	<0.025	<0.025	
2-METHYLFURAN	<0.025	<0.025	
ETHYLACETATE	TRACE	<0.025	
HEXANE	<0.025	<0.025	
CHLOROFORM	<0.025	<0.025	
2-BUTENAL	TRACE	<0.025	
1,2-DICHLOROETHANE	<0.025	<0.025	
1,1,1-TRICHLOROETHANE	<0.025	<0.025	
N-BUTANOL	TRACE	<0.025	
BENZENE	<0.025	<0.025	
CARBONTETRACHLORIDE	<0.025	<0.025	
2-PENTANONE	0.042	<0.025	
2-METHYLHEXANE	<0.025	<0.025	
2,3-DIMETHYL PENTANE	<0.025	<0.025	
PENTANAL	0.086	<0.025	
3-METHYLHEXANE	<0.025	<0.025	
1,2-DICHLOROPROPANE	<0.025	<0.025	
1,4-DIOXANE	<0.025	<0.025	
TRICHLOROETHENE	<0.025	<0.025	
2,5-DIMETHYLFURAN	<0.025	<0.025	
N-HEPTANE	<0.025	<0.025	
4-METHYL-2-PENTANONE	<0.025	<0.025	
CIS-1,3-DICHLOROPROPENE	<0.025	<0.025	
2-PENTENAL	<0.025	<0.025	
TRANS-1,3-DICHLOROPROPENE	<0.025	<0.025	
1,1,2-TRICHLOROETHANE	<0.025	<0.025	
TOLUENE	<0.025	<0.025	
HEXANAL	0.067	<0.025	
MESITYLOXIDE	<0.025	<0.025	
1,2-DIBROMOETHANE	<0.025	<0.025	
BUTYLACETATE	<0.025	<0.025	
TETRACHLOROETHENE	<0.025	<0.025	
CHLOROBENZENE	<0.025	<0.025	
ETHYLBENZENE	<0.025	<0.025	
M/P-XYLENES	<0.025	<0.025	
2-HEPTANONE	TRACE	<0.025	
CYCLOHEXANONE	TRACE	<0.025	
HEPTANAL	0.052	<0.025	
STYRENE	<0.025	<0.025	
1,1,2,2-TETRACHLOROETHANE	<0.025	<0.025	
O-XYLENE	<0.025	<0.025	
1,3,5-TRIMETHYL BENZENE	<0.025	<0.025	
1,2,4-TRIMETHYL BENZENE	<0.025	<0.025	
1,3-DICHLOROBENZENE	<0.025	<0.025	
1,4-DICHLOROBENZENE	<0.025	<0.025	
1,2-DICHLOROBENZENE	<0.025	<0.025	
1,2,4-TRICHLOROBENZENE	<0.025	<0.025	
HEXA CHLORO-1,3-BUTADIENE	<0.025	<0.025	

TARGET COMPOUNDS (TOXIC)			
1,3-BUTADIENE	<0.025	<0.025	
ETHYLENE OXIDE	<0.025	<0.025	

CARBON DISULFIDE	<0.025	<0.025
2-METHYL-2-PROPENAL	<0.025	<0.025
3-BUTEN-2-ONE	<0.025	<0.025
2-ETHOXYETHANOL	<0.025	<0.025
DIMETHYLDISULFIDE	<0.025	<0.025
OCTAMETHYLCYCLOTETRASILOXANE	*	*

NON-TARGET COMPOUNDS		
OCTAFLUOROPROPANE	#	#
SULFURHEXAFLUORIDE	0.15	<0.025
BROMOTRIFLUOROMETHANE	1.7	<0.025
HEXAMETHYLCYCLOTRISILOXANE	*	*
C8-KETONE	0.096	<0.025
OCTANAL	0.071	<0.025
DECAMETHYLCYCLOPENTASILOXANE	*	*

TOTAL ALCOHOLS PLUS ACETONE	0.97	0.17
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TARGET COMPOUNDS (GC)***		
CARBON MONOXIDE	<0.57	<0.57
METHANE	7.3	<1.4
HYDROGEN	16	<0.74
CARBON DIOXIDE	2900	1200

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	4.2	0.25
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*Present, subject to large, random variability, therefore not quantifiable

Present, but not quantitated

Not Analyzed

< : Value is less than the laboratory report detection limit.

TRACE: Amount detected is sufficient for compound identification only.

*** Measurements are calibrated by multi-point initial calibration and verified by mid-point continuing calibration.

TABLE 1B
ANALYTICAL RESULTS OF

* FROM GC RESULTS

****FROM GC RESULTS; MeOH Conc.=GC MeOH Conc.-(2* GC/MS ACETALDEHYDE Conc.)**

Present, but not quantitated

Present, subject to large, random variability, therefore not quantifiable

< : Value is less than the laboratory report detection limit

TRACE: Amount detected is sufficient for compound identification only.

*** Measurements are calibrated by multi-point initial calibration and verified by mid-point continuing calibration.

TABLE 2A
ANALYTICAL RESULTS OF
STS-117 GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (7-d SMAC)	
	AA04268 Middeck SN 1088 06/22/07 @ 12:50 GMT	AA04266 Preflight SN 1054 06/08/07 @ 13:58 EDT
	TARGET COMPOUNDS (TO-14/POLAR)	
FREON12	0.00003	ND
CHLOROMETHANE	0.00070	ND
FREON114	ND	ND
METHANOL	0.01261	0.00139
ACETALDEHYDE	0.11764	0.00752
VINYLCHLORIDE	ND	ND
BROMOMETHANE	ND	ND
ETHANOL	0.00025	0.00001
CHLOROETHANE	ND	ND
ACETONITRILE	0.00187	0.00187
PROPENAL	0.41667	ND
ACETONE	0.00584	0.00077
PROPANAL	0.01097	0.00087
ISOPROPANOL	0.00026	0.00067
FREON11	ND	ND
FURAN	ND	ND
ACRYLONITRILE	ND	ND
PENTANE	0.00002	ND
2-METHYL-2-PROPANOL	0.00008	ND
METHYLACETATE	ND	ND
1,1-DICHLOROETHENE	ND	ND
DICHLOROMETHANE	0.00025	ND
3-CHLOROPROPENE	ND	ND
FREON113	ND	ND
N-PROPANOL	0.00013	ND
1,1-DICHLOROETHANE	ND	ND
BUTANAL	0.00619	0.00071
2-BUTANONE	0.00254	0.00042
CIS-1,2-DICHLOROETHENE	ND	ND
2-METHYLFURAN	ND	ND
ETHYLACETATE	0.00007	ND
HEXANE	ND	ND
CHLOROFORM	ND	ND
2-BUTENAL	0.00735	ND
1,2-DICHLOROETHANE	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
N-BUTANOL	0.00016	ND
BENZENE	ND	ND
CARBONTETRACHLORIDE	ND	ND
2-PENTANONE	0.00060	ND
2-METHYLHEXANE	ND	ND
2,3-DIMETHYL PENTANE	ND	ND
PENTANAL	0.00406	ND
3-METHYLHEXANE	ND	ND
1,2-DICHLOROPROPANE	ND	ND
1,4-DIOXANE	ND	ND
TRICHLOROETHENE	ND	ND
2,5-DIMETHYL FURAN	ND	ND
N-HEPTANE	ND	ND
4-METHYL2-PENTANONE	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND
2-PENTENAL	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND
TOLUENE	ND	ND
HEXANAL	0.00272	ND
MESITYLOXIDE	ND	ND
1,2-DIBROMOETHANE	ND	ND
BUTYLACETATE	ND	ND
TETRACHLOROETHENE	ND	ND
CHLOROBENZENE	ND	ND
ETHYLBENZENE	ND	ND
M/P-XYLENES	ND	ND
2-HEPTANONE	0.00054	ND
CYCLOHEXANONE	0.00021	ND
HEPTANAL	0.00186	ND
STYRENE	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND
O-XYLENE	ND	ND
1,3,5-TRIMETHYL BENZENE	ND	ND
1,2,4-TRIMETHYL BENZENE	ND	ND
1,3-DICHLOROBENZENE	ND	ND
1,4-DICHLOROBENZENE	ND	ND
1,2-DICHLOROBENZENE	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND
HEXA CHLORO-1,3-BUTADIENE	ND	ND
TARGET COMPOUNDS (TOXIC)		
1,3-BUTADIENE	ND	ND
ETHYLENE OXIDE	ND	ND
CARBON DISULFIDE	ND	ND
2-METHYL-2-PROPENAL	ND	ND
3-BUTEN-2-ONE	ND	ND
2-ETHOXYETHANOL	ND	ND
DIMETHYLDISULFIDE	ND	ND
OCTAMETHYLCYCLOTETRA SILOXANE	*	*
NON-TARGET COMPOUNDS		
OCTAFLUOROPROPANE	#	#
SULFURHEXAFLUORIDE	0.00013	ND
BROMOTRIFLUOROMETHANE	0.00016	ND
HEXAMETHYLCYCLOTRISILOXANE	*	*
C8-KETONE	0.00368	ND
OCTANAL	0.00225	ND
DECAMETHYLCYCLOPENTASILOXANE	*	*
TARGET COMPOUNDS (GC)		
CARBON MONOXIDE	0.00000	0.00000
METHANE	0.00192	0.00000
HYDROGEN	0.04821	0.00000
CARBON DIOXIDE	0.22524	0.09253
TOTAL T-VALUE		0.87518
		0.10675

*Present, but not included in total T-Value

Present, but not calculated

Not Analyzed

ND : Value is less than the laboratory report detection limit.

Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2B
ANALYTICAL RESULTS OF

* FROM GC RESULTS

****FROM GC RESULTS; MeOH Conc.=GC MeOH Conc.-(2* GC/MS ACETALDEHYDE Conc.)**

Present, but not calculated

Present, but not included

ND : Value is less than the laboratory report detection limit

Note: Number of decimal places in T-Values do not represent significant figures of measurements